Listing of Claims:

This listing of the claims will replace all prior versions, and listings, of claims in the application:

1. (Withdrawn) A method for adaptive reduction of ringing artifacts in an input image including pixels of image information, comprising the steps of: (a) selecting a pixel window including a set of pixels from the input image pixels; (b) detecting areas of ringing artifacts in the pixel window based on the pixel information; (c) processing the pixels in the detected areas to reduce the detected ringing artifacts in those areas; and (d) generating an enhanced output image including the processed pixels with reduced ringing artifacts.

2. (Withdrawn) The method of claim 1, wherein in step (b) detecting the areas of ringing artifacts includes the steps of: detecting areas of ringing artifacts in the pixel window as a function of gradation level differences between one or more pixels therein.

3. (Withdrawn) The method of claim 1, wherein in step (b) detecting the areas of ringing artifacts includes the steps of: for a pixel in the window, determining the gradation level difference between that pixel and that of neighboring pixels; and detecting if the gradation level difference is within a selected threshold, indicating ringing-like artifacts proximate the pixel position in the window.

4. (Withdrawn) The method of claim 1, wherein in step (c) processing said pixels includes the steps of performing low pass filtering of the pixels to reduce the ringing artifacts.

5. (Withdrawn) The method of claim 1, wherein in step (c) processing said pixels includes the steps of performing smoothing on the pixels to reduce the ringing artifacts.

6. (Withdrawn) The method of claim 1, wherein in step (d) generating an enhanced output image further includes the steps of: generating an enhanced output image comprising: (i) the processed window pixels with reduced ringing artifacts, and (ii) the remaining window pixels.

7. (Withdrawn) The method of claim 1 wherein the input image comprises a decompressed image.

8. (Withdrawn) A method for adaptive reduction of ringing artifacts in an input image including pixels of image information, comprising the steps of: (a) selecting a pixel window including a set of pixels from the input image pixels; (b) detecting areas of ringing artifacts in the pixel window based on the pixel information; (c) processing the pixels in the window to generate processed pixels including pixels with reduced ringing artifacts; (d) selecting pixels with reduced ringing artifacts from the processed pixels, based on the detected ringing artifact areas; and (e) generating an enhanced output image comprising: (i) the selected pixels, and (ii) the remaining window pixels.

9. (Withdrawn) The method of claim 8, wherein in step (b) detecting the areas of ringing artifacts includes the steps of: detecting areas of ringing artifacts in the pixel window as a function of gradation level differences between one or more pixels therein.

10. (Withdrawn) The method of claim 8, wherein in step (b) detecting the areas of ringing artifacts includes the steps of: for a pixel in the window, determining the gradation level difference between that pixel and that of neighboring pixels; and detecting if the gradation level difference is within a selected threshold, indicating ringing-like artifacts proximate the pixel position in the window.

11. (Withdrawn) The method of claim 8, wherein in step (c) processing said pixels includes the steps of performing low pass filtering of the pixels to reduce ringing artifacts.

12. (Withdrawn) The method of claim 8, wherein in step (c) processing said pixels includes the steps of performing smoothing on the pixels to reduce ringing artifacts.

13. (Withdrawn) The method of claim 8 wherein the input image comprises a decompressed image.

14. (Withdrawn) A method for adaptive reduction of ringing artifacts in an input image including pixels of image information, comprising the steps of: (a) selecting a pixel window including a set of pixels from the input image pixels; (b) detecting areas of ringing artifacts in the pixel window based on the pixel information; (c) determining local variance of each pixel in the window with respect to neighboring pixels; (d) based on the local variances, detecting if the location of the window is proximate a noisy area in the input image; (e) processing the window pixels to generate processed pixels including pixels with reduced ringing artifacts; (f) selecting pixels with

reduced ringing artifacts from the processed pixels, based on the detected ringing artifact areas and the detected window location information; and (g) generating an enhanced output image comprising: (i) the selected pixels, and (ii) the remaining window pixels.

15. (Withdrawn) The method of claim 14, wherein in step (b) detecting the areas of ringing artifacts includes the steps of: detecting areas of ringing artifacts in the pixel window as a function of gradation level differences between one or more pixels therein.

16. (Withdrawn) The method of claim 14, wherein in step (b) detecting the areas of ringing artifacts includes the steps of: for a pixel in the window, determining the gradation level difference between that pixel and that of neighboring pixels; and detecting if the gradation level difference is within a selected threshold, indicating ringing-like artifacts proximate the pixel position in the window.

17. (Withdrawn) The method of claim 14, wherein in step (e) processing said pixels includes the steps of performing low pass filtering of the pixels to reduce ringing artifacts.

18. (Withdrawn) The method of claim 14, wherein in step (e) processing said pixels includes the steps of performing smoothing on the pixels to reduce ringing artifacts.

19. (Withdrawn) The method of claim 14 wherein the input image comprises a decompressed image.

20. (Withdrawn) The method of claim 14, wherein in step (f) selecting pixels with reduced ringing artifacts from the processed pixels, further includes the steps of: (f) selecting pixels with reduced ringing artifacts from the processed pixels in the detected ringing artifact areas, based on the window location information.

21. (Withdrawn) The method of claim 14, wherein in step (f) selecting pixels with reduced ringing artifacts from the processed pixels, further includes the steps of: (f) selecting pixels with reduced ringing artifacts from the processed pixels in the detected ringing artifact areas, substantially in noisy picture locations.

22. (Previously presented) A device that adaptively reduces ringing artifacts in an input image including pixels of image information, comprising:

a ringing-artifact detector that detects areas of ringing artifacts in a pixel window based on the pixel information, the pixel window including a set of pixels from the input image pixels;

an image processor that processes window pixels to generate pixels with reduced ringing artifacts; and

a combiner that selects the processed pixels with reduced ringing artifacts in the detected ringing-artifact areas, and generates an output image comprising: (i) the selected processed pixels with reduced ringing artifacts, and (ii) the remaining window pixels from the input image;

whereby the output image includes portions of the input image where ringing artifacts were not detected, and portions of the processed image corresponding to areas in the input image where ringing artifacts were detected, such that the output image is an enhanced version of the input image with ringing artifacts substantially reduced.

23. (Previously presented) The device of claim 22, wherein the ringing-artifact detector comprises a pattern detection function that detects ringing pattern-like features indicating the areas of ringing in the pixel window as a function of gradation level differences between one or more pixels therein.

24. (Original) The device of claim 22, wherein the ringing-artifact detector determines the gradation level difference between a pixel and that of neighboring pixels, and detects if the gradation level difference is within a selected threshold, indicating ringing-like artifacts proximate that pixel position in the window.

25. (Previously presented) The device of claim 22, wherein the image processor includes a low pass filter that applies low pass filtering to the image pixels to generate pixel with reduced ringing artifacts.

26. (Previously presented) The device of claim 22, wherein the image processor includes a smoother that reduces ringing artifacts.

27. (Previously presented) The device of claim 22, further comprising:

a variance detector that determines local variance of each pixel in the window with respect to neighboring pixels, wherein the local variances indicate presence of noisy areas in the image;

a signal detector that based on the local variances, detects if the location of the window is proximate a noisy area in the input image;

such that the combiner further selects pixels with reduced ringing artifacts from the processed pixels, based on the detected ringing artifact areas and the detected window location information, and generates that enhanced output image comprising: (i) the selected pixels with reduced ringing artifacts, and (ii) the remaining window pixels from the input image.

28. (Previously presented) The device of claim 27, wherein the combiner selects pixels with reduced ringing artifacts from the processed pixels in the detected ringing artifact areas, based on the window location information.

29.(Previously presented) The device of claim 28, wherein the combiner selects pixels with reduced ringing artifacts from the processed pixels in the detected ringing artifact areas, corresponding to substantially noisy input image locations.

30. (Previously presented) The device of claim 22 wherein the input image comprises a decompressed image, such that said ringing artifacts were generated by image compression and/or decompression.

31. (Previously presented) The device of claim 23 wherein the larger the gradation level difference between a pixel and its neighboring pixels, then the lower the ringing artifact effect.

32. (Previously presented) The device of claim 27 wherein the variance detector determines the local deviation in the image.

33. (Previously presented) The device of claim 27 wherein the combiner selectively combines portions of input image with portions of processed image based on proximity of the window to a ringing artifact area, to generate the output image in which ringing artifact areas are substantially suppressed.

34. (Currently amended) ~~The device of claim 33~~ A device that adaptively reduces ringing artifacts in an input image including pixels of image information, comprising:

a ringing-artifact detector that detects areas of ringing artifacts in a pixel window based on the pixel information, the pixel window including a set of pixels from the input image pixels;

an image processor that processes window pixels to generate pixels with reduced ringing artifacts;

a combiner that selects the processed pixels with reduced ringing artifacts in the detected ringing-artifact areas, and generates an output image comprising: (i) the selected processed pixels with reduced ringing artifacts, and (ii) the remaining window pixels from the input image;

a variance detector that determines local variance of each pixel in the window with respect to neighboring pixels, wherein the local variances indicate presence of noisy areas in the image; and

a signal detector that based on the local variances, detects if the location of the window is proximate a noisy area in the input image;

such that the combiner further selects pixels with reduced ringing artifacts from the processed pixels, based on the detected ringing artifact areas and the detected window location information, and generates that enhanced output image comprising: (i) the selected pixels with reduced ringing artifacts, and (ii) the remaining window pixels from the input image;

whereby the output image includes portions of the input image where ringing artifacts were not detected, and portions of the processed image corresponding to areas in the input image where ringing artifacts were detected, such that the output image is an enhanced version of the input image with ringing artifacts substantially reduced;

wherein the combiner selectively combines portions of input image with portions of processed image based on proximity of the window to a ringing artifact area, to generate the output image in which ringing artifact areas are substantially suppressed;

wherein the closer the window to a ringing artifact area, the higher the portion of the processed image that the combiner selects for the output image.

35. (Currently amended) ~~The device of claim 33~~ A device that adaptively reduces ringing artifacts in an input image including pixels of image information, comprising:

a ringing-artifact detector that detects areas of ringing artifacts in a pixel window based on the pixel information, the pixel window including a set of pixels from the input image pixels;

an image processor that processes window pixels to generate pixels with reduced ringing artifacts;

a combiner that selects the processed pixels with reduced ringing artifacts in the detected ringing-artifact areas, and generates an output image comprising: (i) the selected processed pixels with reduced ringing artifacts, and (ii) the remaining window pixels from the input image;

a variance detector that determines local variance of each pixel in the window with respect to neighboring pixels, wherein the local variances indicate presence of noisy areas in the image; and

a signal detector that based on the local variances, detects if the location of the window is proximate a noisy area in the input image;

such that the combiner further selects pixels with reduced ringing artifacts from the processed pixels, based on the detected ringing artifact areas and the detected window location information, and generates that enhanced output image comprising: (i) the selected pixels with reduced ringing artifacts, and (ii) the remaining window pixels from the input image;

whereby the output image includes portions of the input image where ringing artifacts were not detected, and portions of the processed image corresponding to areas in the input image where ringing artifacts were detected, such that the output image is an enhanced version of the input image with ringing artifacts substantially reduced;

wherein the combiner selectively combines portions of input image with portions of processed image based on proximity of the window to a ringing artifact area, to generate the output image in which ringing artifact areas are substantially suppressed;

wherein the farther the window from a ringing artifact area, the higher the portion of the input image that the combiner selects for the output image.

36. (Previously presented) The device of claim 22 wherein the ringing-artifact detector comprises:

a pattern detection function that detects ringing pattern-like features in the window;

a variance detector that determines local variance of each pixel in the window with respect to neighboring pixels, wherein the local variances indicate presence of noisy areas in the image;

a signal detector that based on the local variances, detects if the location of the window is proximate a noisy area in the input image;

a ringing-like area detection function that, based on the detected noisy area and the detected ringing-like pattern, determines proximity of the window to a ringing-like area in the input image; and

wherein the combiner selectively combines pixel from portions of the input image with portion of the processed pixels based on proximity of the window to a ringing-like area, to generate the output image wherein ringing-like artifacts are substantially reduced.

37. (Currently amended) ~~The device of claim 36~~ A device that adaptively reduces ringing artifacts in an input image including pixels of image information, comprising:

a ringing-artifact detector that detects areas of ringing artifacts in a pixel window based on the pixel information, the pixel window including a set of pixels from the input image pixels;

an image processor that processes window pixels to generate pixels with reduced ringing artifacts; and

a combiner that selects the processed pixels with reduced ringing artifacts in the detected ringing-artifact areas, and generates an output image comprising: (i) the selected processed pixels with reduced ringing artifacts, and (ii) the remaining window pixels from the input image;

whereby the output image includes portions of the input image where ringing artifacts were not detected, and portions of the processed image corresponding to areas in the input image

where ringing artifacts were detected, such that the output image is an enhanced version of the input image with ringing artifacts substantially reduced;

wherein the ringing-artifact detector comprises:

a pattern detection function that detects ringing pattern-like features in the window;

a variance detector that determines local variance of each pixel in the window with respect to neighboring pixels, wherein the local variances indicate presence of noisy areas in the image;

a signal detector that based on the local variances, detects if the location of the window is proximate a noisy area in the input image;

a ringing-like area detection function that, based on the detected noisy area and the detected ringing-like pattern, determines proximity of the window to a ringing-like area in the input image; and

wherein the combiner selectively combines pixel from portions of the input image with portions of the processed pixels based on proximity of the window to a ringing-like area, to generate the output image wherein ringing-like artifacts are substantially reduced;

wherein the closer the window to a ringing artifact area, the higher the portion of the processed pixels that the combiner selects for the output image.

38. (Currently amended) ~~The device of claim 36~~ A device that adaptively reduces ringing artifacts in an input image including pixels of image information, comprising:

a ringing-artifact detector that detects areas of ringing artifacts in a pixel window based on the pixel information, the pixel window including a set of pixels from the input image pixels;

an image processor that processes window pixels to generate pixels with reduced ringing artifacts; and

a combiner that selects the processed pixels with reduced ringing artifacts in the detected ringing-artifact areas, and generates an output image comprising: (i) the selected processed pixels with reduced ringing artifacts, and (ii) the remaining window pixels from the input image;

whereby the output image includes portions of the input image where ringing artifacts were not detected, and portions of the processed image corresponding to areas in the input image where ringing artifacts were detected, such that the output image is an enhanced version of the input image with ringing artifacts substantially reduced;

wherein the ringing-artifact detector comprises:

a pattern detection function that detects ringing pattern-like features in the window;

a variance detector that determines local variance of each pixel in the window with respect to neighboring pixels, wherein the local variances indicate presence of noisy areas in the image;

a signal detector that based on the local variances, detects if the location of the window is proximate a noisy area in the input image;

a ringing-like area detection function that, based on the detected noisy area and the detected ringing-like pattern, determines proximity of the window to a ringing-like area in the input image; and

wherein the combiner selectively combines pixel from portions of the input image with portions of the processed pixels based on proximity of the window to a ringing-like area, to generate the output image wherein ringing-like artifacts are substantially reduced;

wherein the farther the window from a ringing artifact area, the higher the portion of the input image pixels that the combiner selects for the output image.

39. (Previously presented) A device that adaptively reduces ringing artifacts in an input image including pixels of image information, comprising:

(a) a processor that processes the input image $\{I_n\}$ to generate processed image pixels $I_{LPF}(y,x)$ with reduced ringing artifacts; and

(b) a detector comprising:

a local deviation calculator that calculates the deviation $\sigma(y,x)$ for each pixel in a window in the input image $\{I_n\}$, based on neighboring pixels in the window;

a signal detector that uses the local deviation $\sigma(y,x)$ in a signal detection function $\beta(y,x)$ to detect if the window is in a noisy area in the input image, wherein a small local deviation indicates a noisy area;

a ringing-like pattern detector that detects ringing-like patterns in the window using a ringing-like pattern detection function $g(y,x)$;

a ringing-like area detection function that, based on the detected noisy area and the detected ringing-like pattern, determines proximity of the window to a ringing-like area in the input image; and

(c) a combiner that selectively combines portions of input image $\{I_n\}$ with portions of processed image $I_{LPF}(y,x)$ based on proximity of the window to a ringing-like area, to generate enhanced signal J (y, x) in which ringing-like artifacts are substantially reduced.